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LAND USE IN RELATION TO THE BEET LEAFHOPPER IN SOUTHERN IDAHO

by

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The primary purpose of this paper is to emphasize at this time the importance of proper land use in combating the beet leafhopper (Circulifer tenellus (Bak.)) in southern Idaho. This subject was presented effectively by Piemeisel and Chamberlin 2/ in 1936. These authors stressed that this method "is based essentially on the idea that the proper use of lands now intermittently farmed or destructively grazed will hasten the natural replacement of the weed hosts by nonhosts, a process that takes place to a limited extent on these weedy areas even under present conditions. The problem is similar in all of the States west of the Rocky Mountains, hence the essentials of the control may be applied throughout these States." Extensive observations since 1936 have corroborated the principles advanced by the authors of the above-named bulletin.

The beet leafhopper, commonly referred to in the West as the "white-fly," is a tiny insect slightly more than one-eighth of an inch long and varying in color from gray to greenish yellow. It is a sun-loving, dry-climate, insect whose distribution in North America is confined generally to the arid and semi-arid regions of the western United States and northern Mexico, where it is found breeding on many species of introduced weeds now generally established on nonagricultural and deteriorated range lands.

1/ In cooperation with the Idaho Agricultural Experiment Station.

2/ Piemeisel, R. L. and J. C. Chamberlin. Land-Improvement Measures in Relation to a Possible Control of the Beet Leafhopper and Curly Top. U. S. Dept. Agr. Cir. 416, 24 pp., illus. 1936.

This insect feeds by sucking juices from its host plants and rarely becomes sufficiently numerous to cause any great direct damage by its feeding activities. It is, however, the carrier of the virus of curly top disease, one of the most destructive of all virus diseases affecting sugar beets, beans, tomatoes, spinach, Swiss chard, various species of the melon family, many ornamental flowering plants, and a large number of weeds. The virus of curly top survives the winter in both the beet leafhopper and its winter host plants. It is transmitted by the leafhopper from its host plants to other weed hosts and cultivated susceptible crops during the spring movement. Some of these crops in their seedling stage are very susceptible to the curly-top disease and infected plants often die. The percentage of the spring-generation leafhoppers carrying the virus of curly top has varied appreciably from year to year, with a low of 4 percent in one year to a high of 73 percent in another.

Young plants are usually more susceptible to injury by curly top than are older, well grown plants. In southern Idaho, the magnitude and time of the spring movement of the leafhoppers from its wild host plant breeding areas into susceptible crops are important factors, therefore, in determining the extent of curly-top epidemics, since in some years, the spring movement coincides with the susceptible stage of beets and in other years with beans, which accounts for the sporadic injury to these crops.

In areas where curly top occurs as an epidemic, it has been the most destructive of all bean, beet, and tomato diseases. The development of varieties of sugar beets which are resistant to curly top has lessened the losses to this crop. There are no commercial varieties of tomatoes that are resistant to curly top, and practically a complete loss of this crop occurs in home gardens in southern Idaho during years of drastic curly-top

exposure. Most varieties of garden or snap beans are susceptible to curly top. The popular varieties of snap beans are the most susceptible. Southern Idaho produces approximately 80 percent of the national requirement of garden seed beans since it is the last frontier where seed beans free from bacterial blight and other seed-borne diseases can be successfully grown.

Curly top not only causes large periodic losses to the sugar-beet, bean, and tomato industries but actually limits very markedly the areas in which susceptible crops can be successfully grown. This limitation is so severe that the growing of curly top-susceptible crops is rendered commercially impossible in many sections otherwise suitable.

In southern Idaho the beet leafhoppers pass the winter in the adult stage. Females are fertilized in the fall and live until spring, but males die during the winter. Egg-laying normally begins in March, and adults of the first, or spring, generation appear in May or June. This generation is produced on spring weed hosts, chiefly mustards. Under favorable conditions, the seeds of these weeds germinate in the fall, but occasionally additional germination occurs in the spring. The fall-germinated plants develop small rosettes of leaves, remain alive throughout the winter, and complete their growth the following spring. They mature and dry about the time the spring-generation leafhopper reaches the adult, or winged, stage, and when weather conditions are favorable for flight, the leafhoppers move to their summer hosts, the progress of which coincides with the maturation of the insect. They travel with the wind and infest practically all of the host plants in their path. It is during this spring movement that the cultivated crops are infested. The leafhoppers moving into the cultivated areas alight first in the fields nearest the spring breeding grounds and gradually move farther into the cultivated lands; consequently, beets, beans, tomatoes, and other

susceptible crops situated nearest the breeding grounds are more heavily infested than those farther away and are, therefore, more seriously affected with the curly-top disease transmitted by the leafhopper. Of the cultivated plants, beets are the only important breeding host. During the spring migration, this leafhopper will feed on beans, tomatoes, and other crops but will not reproduce on these plants.

Since the beet leafhopper does not hibernate during the winter but must feed when temperature permits activity, it requires a sequence of host plants. The principal plants on which this leafhopper overwinters and produces a spring generation in southern Idaho are chiefly mustards, the most important being flixweed (Descurainia sophia (Lam.) Webb.), green tansymustard (D. pinnata spp. filipes (A. Gray) Detling), perfoliate pepper-grass (Lepidium perfoliatum L.), and tumblemustard (Sisymbrium altissimum L.). The summer weed hosts are Russian-thistle (Salsola kali var. tenuifolia Tausch), smotherweed (Bassia hyssopifolia (Pall.) Kuntze), and the recently introduced halogeton (Halogeton glomeratus (Bieb.) C. A. Mey).

With the maturing and drying of the summer hosts in the early fall, the leafhoppers move to their winter hosts. If Russian-thistle and smotherweed dry before the winter hosts germinate, the leafhoppers may be forced to feed on sagebrush (Artemisia tridentata Nutt.), rabbitbrush (Chrysothamnus spp.), or on most any plant that is green at this time of the year until the winter hosts germinate. Of the important spring and summer weed hosts listed above, only green tansymustard, or sage mustard, is a native of the United States. The others are introduced plants that have become established on abandoned, waste, and deteriorated range lands. The misuse of the land by man created conditions favorable for the establishment of weeds over large areas, which became breeding grounds for the insect and reservoirs for the virus.

During World War I, the demand for agricultural products increased, prices soared, and sagebrush lands were cleared with a surge and scope unparalleled in history. Destruction of native vegetation occurred over large acreages in southern Idaho for both dry and irrigated farms. Prices of farm products declined, and dry seasons followed the signing of the Armistice. Low prices and successive crop failures, which were caused by a water shortage on the Salmon tract, on the Oakley project, and on the dry-farmed lands northwest of Minidoka and elsewhere resulted in the abandonment of larges acreages. This occurred gradually at first but grew more rapid as conditions grew worse. With the abandonment of large acreages of cultivated lands, these alien weeds became established on these lands as they became idle. The establishment of mustards and Russian-thistle on such large acreages created conditions that were very favorable for the development of this leafhopper. During the spring movement, millions of these insects were carried by the wind to sugar-beet fields, and the curly-top disease carried by them reduced the yields below a profitable crop. The sugar factory at Nampa, Idaho, was dismantled and moved to another place, only to be dismantled and moved again when it was found that the new area was subject to invasion by the insect.

The development of varieties of sugar beets resistant to curly top has made it profitable to grow beets again in areas of the western part of the United States that are affected by the beet leafhopper. However, even these resistant varieties are susceptible to curly top during the early stages of their growth. When a large spring movement of beet leafhoppers has coincided with the seedling stage of the plant, serious losses from curly top have occurred in Idaho and other states. For example, in 1941 a serious curly-top epidemic occurred in southern Idaho, and the average yield of sugar beets in the affected areas that included Castleford,

Cedar, Gooding, Jerome, Richfield, Shoshone, and Wendell was reduced to 8.98 tons per acre, as compared with the 15-year average of 16.60 tons per acre for the Twin Falls factory district, comprising an estimated loss of 7.62 tons per acre.

Range fires on the Snake River plains in southern Idaho and eastern Oregon destroy nonhost plants of the beet leafhopper on thousands of acres of grazing lands each season. The Bureau of Land Management reported over 1,200,000 acres of range lands burned over in southern Idaho in 1941, practically all of which were on the Snake River plains. Observations of the writer indicate that range fires generally have their origin where downy chess (Bromus tectorum L.), an introduced annual grass, forms the plant cover or has entered deteriorated sagebrush areas to such an extent that it will carry fires. When downy chess matures and dries in the early summer, it becomes highly inflammable. During the fire season, it is the greatest range fire hazard in the Intermountain Region, as it will burn like tinder. If this annual grass is burned under favorable conditions, it may reseed itself and again form the cover, but under unfavorable conditions, such as wind erosion and trampling by livestock, mustards, principally tumblemustard, and Russian-thistle may appear. The process from mustards and Russian-thistle to downy chess and then back to these weeds may continue in an endless cycle.

The nature of the successive changes in weedy plant cover that take place in southern Idaho on abandoned fields are: First, Russian-thistle; second, mustards, either flixweed or tumblemustard; and third, downy chess. On burned sagebrush areas, tumblemustard is generally first and then downy chess, but with further disturbance either Russian-thistle appears or the ground may become bare. Sometimes it goes from mustards to downy chess.

Mixed stands of Russian-thistle and mustards are the most important combinations of weed hosts for leafhopper reproduction, since the leafhoppers can overwinter and reproduce their spring and summer generations in the same area.

During the period ending approximately in 1945 the extensive Russian-thistle areas, such as Hollister-Rogerson, Oakley, and Minidoka-Kimama, were located on abandoned farm lands that were privately owned. However, after abandonment many of these farms reverted to public ownership. These areas were located south and northeast of the large irrigated districts, and since the prevailing winds are from the west and the beet leafhopper moves with the wind, the direction of the leafhopper movement in the spring was opposite from the cultivated lands. Russian-thistle on these areas has been greatly reduced during recent years by its replacement with downy chess. During the period 1945-1949 important Russian-thistle acreages developed in the Glenns Ferry-King Hill and Bliss-Tuttle areas on range lands that were originally covered with sage, but which were burned during recent years. Tumblemustard, a spring weed host, is growing intermixed with the Russian-thistle over a considerable proportion of this acreage. These areas lie to the west of the irrigated lands of south-central Idaho and are strategically situated from the standpoints of abundant leafhopper production and movement in the direction of prevailing winds to susceptible crops grown in those lands. The soil is sandy, which is favorable for the overwintering and early spring reproduction of the leafhopper. The winters are milder and the springs are warmer than in the Twin Falls area.

These important Russian-thistle areas are located on range lands that are largely federal- and state-owned, as shown in table 1. The

Table 1

Ownership of lands infested with Russian-thistle in Elmore, Gooding, and Owyhee Counties, Idaho, during the summer of 1949

Area	Approximate acreages owned by			
	Federal	State	Private	Total
	Acres	Acres	Acres	Acres
Glenns Ferry	21,881	1,950	3,000	26,831
Hammett	5,926	100	1,040	7,066
Indian Cove	17,111	1,100	3,280	21,491
King Hill	12,844	640	500	13,984
Tuttle-Bliss	4,236	1,340	3,822	9,398
Total	61,998	5,130	11,642	78,770
Percent	78.7	6.5	14.8	

information given in this table was obtained in cooperation with the Bureau of Land Management, U. S. Department of the Interior, Owyhee District Office, Boise, Idaho, and the Shoshone District Office, Shoshone, Idaho. Table 1 shows the ownership of lands which were infested with Russian-thistle during the summer of 1949 in Elmore, Gooding, and Owyhee Counties in Idaho. This table also shows the total acreage to be 78,770 acres, of which 61,998 acres, or 78.7 percent, are owned by the Federal Government and 5,130 acres, or 6.5 percent, by the State of Idaho.

To illustrate the importance of these weed areas in the current beet leafhopper problem it may be stated that during September 1949 Russian-thistle occupied an average of 54 percent of each acre examined in the King Hill-Glenns Ferry area and that the Russian-thistle plants were infested, on an average, by 57 beet leafhoppersper square foot of land surface occupied. On this basis, there were approximately 1,340,779 beet leafhoppers per acre or an estimated total of nearly 55 billion of these insects infesting the 40,815 acres comprising the combined King Hill-Glenns Ferry acreage shown in the above table.

Chemical control of the beet leafhopper and curly top on cultivated susceptible crops has not proved practical, as continuous infection of the crops occurs by reinfestation during the susceptible period. Therefore, other methods for a feasible control have been developed. First, the major host plants of this insect have been determined and methods for their replacement by nonhost perennial grasses have been studied. The replacement of weed hosts by perennial grasses that are not breeding hosts of the beet leafhopper may best be accomplished by reseeding the abandoned and burned areas, or if native perennial grasses are still present, protection against grazing will accomplish the same purpose. Since these perennial grasses remain green until late in the season, they do not constitute a fire hazard when compared with downy chess.

The second method is the chemical control of the beet leafhopper in weed host areas that contribute large populations to the cultivated areas. This is a continuing program designed to keep the beet leafhopper populations below injurious numbers. This program would decrease as the weed-host areas decreased and new ones were prevented by range management. The control of annual weeds on idle and waste lands in and adjoining cultivated areas is the most difficult phase of range management, as there are constant grazing and trampling by livestock and misuse by man. In such areas chemical control would be the most practicable.